

# METHOD TO SEPARATE ETHANOL FROM A FERMENTATION BROTH

## ABSTRACT

This is a method to withdraw ethanol from a broth contained within a fermentation vessel. Fermentation broth contains sugars, microorganisms and nutrients maintained at a pH and temperature to influence rate of fermentation to form ethanol. Factors within the broth that also effect rate of fermentation are; concentration of sugars, activity of microorganisms and enzymes. These factors are controlled by addition of a mixture containing these constituents followed by removal of sludge and broth to substantially regulate broth volume within the vessel. Fermentation produces heat which must be removed from the broth in order to continue fermentation. Carbon dioxide, provided to the fermentation vessel, evaporates ethanol within the broth, by heat from fermentation, to humidify the carbon dioxide and accordingly regulate ethanol concentration of the broth. Withdrawal of ethanol from the broth achieves ethanol concentration of about 6% to about 12% within the broth. The method employs carbon dioxide, supplied to the fermentation vessel, to humidify ethanol and withdraw ethanol and carbon dioxide formed within the fermentation vessel. The carbon dioxide containing humidified ethanol is removed from the fermentation vessel. The removed ethanol humidified carbon dioxide, containing carbon dioxide produced from fermentation, is then substantially separated from the ethanol, and provides carbon dioxide for recycling to humidify additional ethanol. Broth and sludge, removed from the fermentation vessel, are transformed to substantially separate sludge from broth containing sugars.